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Description

This invention relates generally to a method for producing an information recording disk, such as a video disk, phonograph disk or the like, and more particularly, the present invention relates to a method for producing information recording disks by stamping a synthetic resin by a disk stamper.

There are various methods for producing an information recording disk, and according to one conventional method, a flat layer of a liquid molding resin is provided on a stamper, on which undulations carrying information have been made, then a sheet or flat plate functioning as a backing plate is pressed to the flat layer of the resin so that the resin layer assumes a given thickness, and the resin is hardened by irradiating with a suitable ray.

The above-described method has suffered from a problem of taking air bubbles in the liquid resin, which occurs when placing the backing plate on the liquid resin. In accordance with an earlier proposal the backing plate is supported above the stamper so as to face the stamper, having a given space therebetween, and a given amount of liquid molding resin is injected from an injection valve provided at the center of the stamper into the space. The backing plate is pressed toward the stamper during or after the injection of the liquid molding resin so that the injected resin is stretched outwardly radially. After the resin has been stretched, an ultraviolet ray is irradiated to the resin layer via the backing plate to harden the resin. The resin is adhered to the backing plate when hardening, and an information recording disk can be produced by detaching the hardened resin layer together with the backing plate.

As will be described later with reference to the accompanying drawings, the injection valve used in the conventional method has a flange portion. However, because of the presence of the flange portion, the hardened resin layer of the disk is difficult to detach from the stamper. Namely, a circular edge defined by the upper surface and the peripheral wall of the flange portion is apt to hook the disk when detaching the disk. The inventors of the present invention previously devised a new structure of the flange portion of the injection valve so that the above problem would not occur. In order that the disk can be smoothly detached from the stamper, the circular edge of the flange portion is beveled. Namely, the angle defined between the upper surface and peripheral wall of the flange portion is made obtuse so that the disk is prevented from being hooked by the edge. However, provision of such a beveled edge raises another problem that air bubbles are easy to be taken in the liquid molding resin when the resin is injected into the space between the backing plate and the stamper.

The conventional methods including the above method for producing an information recording disk have suffered from occurrence of air bubbles which are apt to be made in the finished products of the disks. Air bubbles are easy to enter the liquid molding resin when the resin is placed on the stamper and when the resin is stretched by pressing the backing plate toward the stamper. Such air bubbles may result in dropout of information data in both stylus-contact and stylus-noncontact type information recording disks. Signal or data dropout in an information recording disk may result in deterioration of reproduced picture and/or sound quality. Especially in the case of a video disk, since the density of the data or signals is extremely high compared to ordinary phonograph disks, such air bubbles in the disk, which do not raise a serious problem in a phonograph disk, become a source of trouble. In the case of a video disk of the type arranged to be traced by a pickup stylus which is in contact with the surface of the disk, such air bubbles may damage the stylus. Namely, the presence of air bubbles mingled with the resin lowers the commercial value of an information recording disk.

Summary of the Invention

The present invention has been developed in order to remove the above-mentioned disadvantage inherent to the conventional methods for producing an information recording disk.

It is, therefore, an object of the present invention to provide a method for producing information recording disks, with which air bubbles are prevented from being mingled with the liquid molding resin when depositing and stretching it to form a disk, so that productivity can be improved while the quality of information recording disks can be elevated.

In accordance with the present invention there is provided a method of producing information recording disks by pressing a synthetic resin by a disk stamper, comprising the steps of: placing said disk stamper on a stamper mount; supporting a backing plate, which will be a part of an information recording disk to be produced, above said disk stamper so that there is a given space between said backing plate and said disk stamper; injecting a liquid molding resin into said space between said backing plate and said disk stamper through a passage made in an injection valve received in a center bore of a stamper-fixing shaft provided at the center of said stamper mount, said injection valve having a flange portion which can be interposed between said backing plate and said disk stamper; depressing said backing plate toward said disk stamper so that the injected resin is stretched outwardly radially; and irradiating the stretched resin layer by an ultraviolet ray so that said resin is hardened, characterized by a step of wetting at least the periphery of said flange portion of said injection valve by said liquid molding resin before said

flange portion is in contact with said backing plate.

Brief description of the drawings

The object and features of the present invention will become more readily apparent from the following detailed description of the preferred embodiments taken in conjunction with the accompanying drawings in which:

Fig. 1 is a schematic cross-sectional view of a previously proposed device for producing information recording disks;

Fig. 2 is a schematic partial cross-sectional view showing a modification of the device of Fig. 1;

Fig. 3 is an explanatory view showing a state that air bubbles have been taken into the liquid molding resin around the injection valve of the device of Fig. 2;

Figs. 4 to 9 are explanatory views showing the method according to the present invention;

Figs. 10 to 12 are explanatory diagrams showing the contact angle of the liquid molding resin with respect to the stamper;

Fig. 13 is a graphical representation showing the vertical position of the pressing plate of the device used for carrying out the present invention;

Fig. 14 and 15 show a conventional method for making a center hole in a stamper and for shaping the center hole to be readily supported by a stamper fixing shaft;

Fig. 16 is an explanatory view showing a conventional way of supporting the stamper of Fig. 15;

Fig. 17 is a schematic cross-sectional view of a fixing ring which is a part of a stamper assembly according to the present invention;

Fig. 18 is a schematic cross-sectional view of the stamper assembly according to the present invention;

Fig. 19 is an explanatory view showing the state that the stamper assembly of Fig. 18 has been fixed by means of a stamper-fixing shaft to a stamper mount of the device according to the present invention; and

Figs. 20 to 22 are schematic diagrams showing the way of attracting the stamper to a stamper mount by means of magnetic forces.

The same or corresponding elements and parts are designated at like numerals throughout the drawings.

Detailed description of the invention

Prior to describing the present invention, the above-mentioned conventional device and method and its modification will be described for a better understanding of the present invention.

Fig. 1 is a schematic cross-sectional view of previously proposed device which generally comprises a stamper mount 3 fixedly attached to a stand 10, an injection valve 26 having a passage therein, a pressing plate 4 connected to the shaft of an air cylinder 7 which is attached to an arm 82 of the stand 10. The pressing plate 4 is located above the stamper mount 3 so that it faces the latter and is further arranged to move up and down by driving the air cylinder 7. The injection valve 26 is movably received in a stamper-fixing shaft 25 which is screwed in a screw hole made in the stand 10. A plurality of outlets 34 are made in the injection valve 26, where these outlets 34 communicate with the passage made in the center of the injection valve 26. The injection valve 26 comprises a flange portion 35 above the outlets 34, and a center projection integrally formed with the flange portion 35. The pressing plate 4 has a recess 82 at the center thereof for partially receiving the top end of the center projection of the injection valve 26, while the backing plate 2 also has a through hole. The pressing plate 4 has a plurality of air-supply outlets 39 which communicates with a passage 38 connected to a pressured gas source (not shown). An annular recess is made around the center recess 82 for receiving an O-ring 36 made of an elastic material such as rubber. In the device of Fig. 1, pressured gas, such as dried air or nitrogen, from an unshown gas source is arranged to be blown from the air outlets 39. The diameter of each of the air outlets 39 is narrowed so that the speed of the gas is as high as the velocity of sound.

The stamper-fixing shaft 25 has, at its top end, a circular recess in which the flange portion 34 of the injection valve 25 can be partially fitted in.

The device of Fig. 1 operates as follows. First, the stamper 1 is placed on the stamper mount 3 and is fixed by engaging the stamper-fixing shaft 25 with the stand 10. After the stamper 1 has been set, the injection valve 26 is moved upwardly as shown in Fig. 1 and the backing plate 2 is placed on the upper surface of the flange portion 34 of the injection valve 26 with the pressing plate 4 lifted up. The liquid molding resin 9 is injected through the passage of the injection valve 26 into the space between the backing plate 2 and the stamper 1 by pressure feeding the same. During injection or after injection, the pressing plate 4 is lowered by driving the air cylinder 7. Since the O-ring 36 is attached to the pressing plate 4 in such a manner that a portion of the O-ring projects beyond the lower surface of the pressing plate 4, the O-ring 36 comes into contact with the upper surface of the backing plate 2. The pressing plate 4 is further lowered so that the O-ring 36 is deformed. At this time, the above-mentioned gas is blown from the air outlets 39 toward the upper surface of the backing plate 2. Thus, pressure is applied by the gas to the backing plate 2, where the pressure is maximum right below the air outlets 39 which are coaxially arranged with respect to the center of the pressing plate 4. The gas pressure applied to the backing plate 2 lowers along the outward radial directions, and pressure at the

periphery of the backing plate 2 equals the pressure of atmosphere. With this pressure gradient, the backing plate 2 is deformed in such a manner that the distance between the lower surface of the backing plate 2 and the upper surface of the stamper 1 at the periphery of the backing plate 2 is greater than the space between the same at portions closed to the center of the backing plate 2. By the application of the pressure to the backing plate 2 and by the above-mentioned deformation of the same, the liquid molding resin 12 around the outlets 34 is pressed to be stretched outwardly radially.

Fig. 2 illustrates a condition that the resin 12 has been stretched by the above-described process. At this time the lower surface of the flange portion 35 of the injection valve 26 is received in the recess made at the top of the stamper-fixing shaft 25. An ultraviolet ray is applied through the backing plate 2 to the resin 12 so that the resin 12 is hardened. The hardened resin layer is detached together with the backing plate 2 from the stamper 1 to provide a finished product of an information recorded replica disk. In Fig. 1, the flange portion 35 of the injection valve 26 is illustrated such that the peripheral wall thereof is tapered so that the diameter of the upper surface of the flange portion 35 is greater than that of the lower surface thereof. Therefore, when detaching the disk from the stamper 1, the disk is apt to be hooked by the edge portion between the upper surface and the peripheral wall of the flange portion 35, and therefore, it may be difficult to smoothly detach the disk. Because of this problem, the disk may be partly damaged around its center hole. In order to remove this problem, it is preferable that the upper edge of the flange portion 35 is beveled so that the edge takes an obtuse angle in its cross section as shown in Fig. 2 showing a modification of the device of Fig. 1. In Fig. 2 a beveled edge is indicated at a reference 43.

With the provision of such a beveled edge 43, although the disk can be satisfactorily detached from the stamper without being damaged, such a beveled edge 43 of the flange portion 35 may result in occurrence of air bubbles 44 as shown in Fig. 3. Namely, since the liquid resin 9 is injected from the outlet of the injection valve 26, air between the beveled edge 43 and the lower surface of the backing plate 2 is apt to be covered by the injected resin 12, to cause occurrence of air bubbles 44 whose diameter is 50 to 500 micrometers or so. The air bubbles 44 remained at the upper inner corner of the resin 12 leave the corner in the middle of the above-mentioned pressing process, and move outwardly as the liquid molding resin 12 is stretched. If the air bubbles 44 are moved to the outmost portion corresponding to the periphery of the backing plate 2 so that the air bubbles 44 are off the signal recorded portion, there would be no problem. Actually, however, there is little possibility that the air bubbles 44 move to the outmost portion of the stretched resin 12. Namely, pressing process is terminated when air bubbles 44 are in the signal recorded portion which is the most important portion of the disk. Although the number of air bubbles remaining in the disk is several, the presence of such air bubbles will be a defect of an information recording disk, especially in the case of a video disk whose signal density is extremely high. Presence of such air bubbles 44 raises various problems as set forth in the beginning of this specification.

The inventors of the present invention have devised a method for removing the above problem caused by the flange portion 35 having the beveled edge 43. This method will be described with reference to Figs. 4 to 9. Prior to placing the backing plate 2 on the upper surface of the flange portion 35 of the injection valve 26, a small amount of the liquid molding resin 9 is injected from the outlet of the injection valve as shown in Fig. 4. Then the injection valve 26 is lowered, as shown in Fig. 5, so that the beveled edge 43 and the upper surface of the flange portion 35 are covered and wetted by the injected resin 12. Nextly, the injection valve 26 is raised as shown in Fig. 6, opening the outlet of the injection valve 26. The backing plate 2 is then placed on the upper surface of the flange portion 35 as shown in Fig. 7. The resin 12 on the upper surface of the flange portion 35 is pressed by the backing plate 2 so that a portion of the resin 12 is moved outwardly while remaining resin 12 is moved inwardly. The resin 12 moved inwardly from the upper surface of the flange portion 35 will be received in an annular recess 35b made at the upper surface of the flange portion 35. Therefore, the resin 12 is prevented from entering into the space between the center hole of the backing plate 2 and the center projection 29, so that the disk will be readily detached from the stamper after being hardened. Under the condition of Fig. 7, a given amount of resin 12 required for forming a single disk is injected in the same manner as described in connection with the previous embodiments. According to this method, since the corner portion defined between the beveled edge 43 and the lower surface of the backing plate 2 is filled with the resin 12, the problem due to air bubbles does not occur.

In order to carry out the above method, the up/down movement of the injection valve 26 may be automatically controlled by a suitable driving circuit (not shown). Although the position of the injection valve 26 is controlled in the above-described method so that the beveled edge 43 of the flange portion 35 is made wet prior to placing the backing plate 2, the beveled edge 43 may be made wet by the resin 12 manually. Namely, a given amount of the resin 12 may be painted manually around the beveled edge 12 before the backing plate 2

is placed on the upper surface of the flange portion 35.

The stretched resin 12 is then hardened in the same manner as described in the above, and the hardened resin layer fixedly attached to the backing plate 2 is detached from the stamper 1. The detached resin layer has a structure as shown in Fig. 8. Namely, an annular projection 40c is made around the center hole of the backing plate 2 because of the annular recess 35b of the upper surface of the flange portion 35. The annular projection 40c is unnecessary, and therefore, it may be removed by widening the center hole 45 of the backing plate 2 from the state of Fig. 8 to another state of Fig. 9 where a widened center hole is indicated at a reference 45a. In this case, the diameter of the center hole 45 of Fig. 8 should be smaller than the given diameter of the center hole 45a which is obtained after widening. In the case that the diameter of the center hole 45 cannot be widened because the diameter already corresponds to the given value, the annular projection 40c may be left as it stands.

In the above described embodiment, it has been described that the backing plate 2 is pressed by the pressing plate 4 or by the pressured gas from the pressing plate 4 so that the liquid molding resin between the backing plate 2 and the stamper 1 is stretched radially outwardly. The stretching velocity of the liquid molding resin 12 has a relationship with respect to the degree of the occurrence of air bubbles, and this relationship will be described.

It has been recognized by the inventors that small air bubbles (most of which have a diameter which is less than 100 micrometers) are greatly introduced in the liquid molding resin 12 when the stretching speed of the resin 12 exceeds a predetermined value.

A contact angle of a liquid with respect to a solid has a significance in the degree of wetting therebetween. Fig. 10 shows a contact angle θ of the liquid molding resin 12 in the case that the resin 12 is dropped on the stamper 1 positioned horizontally. In the case that the stamper 1 is made of Ni, if the surface thereof is clean, the contact angle θ will be approximately 15 degrees. When the stamper 1 is coated with nonelectrolytic Ni or plated by a different type of Ni plating bath, the value of the above-mentioned θ does not change very much. This contact angle θ is affected by a condition of being left in atmosphere or by a condition of storage. Furthermore, changes in the constituents of the resin and the viscosity do not cause a large change in the contact angle θ, because viscosity is an internal matter of the resin, while the contact angle θ is determined by the mutual action between the surface of the resin and exterior. Accordingly, the liquid molding resin 12 of the type arranged to be hardened by an ultraviolet ray can be said to have a characteristic of wetting the stamper 1 very well. On the other hand, the contact angle of the resin 12 with respect to the backing plate 2 made of polymethyl methacrylate or polyvinyl chloride is between 16 and 23 degrees.

Fig. 11 shows a condition that the liquid molding resin 12 has been injected into the space between the backing plate 2 and the stamper 1. When no external force is applied to the resin 12, the contact angle of the resin 12 with respect to the stamper 1 equals the contact angle θ of Fig. 10. Fig. 12 shows a condition that the resin 12 is stretching outwardly radially as the backing plate 2 receives a downward pressure P. At this time, the resin 12 is stretching at a speed V, and therefore, its contact angle θ' is considerably larger than the contact angle θ of Figs. 10 and 11. From the above analysis, it will be understood that the wetting condition or degree in the case of a travelling resin cannot be discussed on the basis of the wetting condition in the case of a stationary resin.

Namely, in order that the surfaces of the stamper 1 and the backing plate are wetted well by the moving or stretching resin 12, the contact angle θ' in a dynamic condition has to be considered. According to experiments it has been recognized that when the stretching speed V of the liquid molding resin 12 was held less than 5 cm/sec to 10 cm/sec, fine air bubbles were not taken in the resin 12. In order to suppress the stretching speed of the resin 12 below 10 cm/sec, the lowering speed of the pressing plate 4 is controlled. Namely, when pressing and thus stretching the injected liquid molding resin 12 from the state of Fig. 3 to the state of Fig. 2, the lowering speed of the pressing plate 4 is made small. This point will be described with a grephical representation of the vertical position of the pressing plate 4 with respect to time.

In Fig. 13, the reference Y0 indicates the most raised position of the pressing plate 4; Y1, is the position of the same where the O-ring 36 (see Fig. 1) of the pressing plate 4 is in contact with the backing plate 2, and the lowering movement of the pressing plate 4 is stopped to inject the liquid molding resin 9; Y2, is the lowest position of the pressing plate 4 where the injected resin 12 has been completely stretched after further lowering the pressing plate 4 so that the resin 12 assumes a given thickness. Namely, the pressing plate 4 is lowered from time t0 till t1 at a relatively high speed (see curve 46).

At time t1, the O-ring 36 abuts against the upper surface of the backing plate 2 so that the resin 9 is injected in the interval between t1 and t2 (see curve 47). The following interval between t2 and t3 (see curve 48) is for pressing the backing plate 2 to stretch the resin 12, and the interval between t3 and t4 (see curve 49) is for raising the pressing plate 4 at a relatively high speed. It will be understood from the different slopes of these curves that the lowering speed of the pressing plate 4 between t2 and t3

(curve 48) is considerably smaller than that in the interval between t0 and t1 (curve 46). The slow speed in the interval between t2 and t3 is set to a value so that the stretching speed V of the liquid molding resin 12 does not exceed 10 cm/sec.

Although the contact angle does not change with the viscosity of the resin very much, the stretching speed V of the resin varies in accordance with the viscosity thereof. Namely, the lower the viscosity, the faster the stretching speed. Consequently, in the case of a low viscosity resin, it is necessary to further reduce the lowering speed of the pressing plate 4 so that the stretching speed of the resin 12 is maintained below 10 cm/sec. The upper limit of the viscosity of resins which can be used as the material of information recording disks, is approximately 5000 to 10000 centipoise. In order to suppress the stretching speed below 10 cm/sec even in the case of a resin having low viscosity, it is necessary to suppress the lowering speed of the pressing plate 4 below several millimeters per second during the period between t2 and t3 (curve 48) of Fig. 13. The lowering speed of the curve 46 as well as the raising speed 49 of the curve 49 may be set much greater than the speed of the curve 48.

At the beginning of the curve 48 of Fig. 13 the lowering slope becomes gentler because the resin 12 is in a state that it is readily stretched immediately after the injection of the same while the space between the backing plate 2 and the stamper 1 is relatively great, and because the lowering speed lowers as the thickness becomes smaller and smaller to approach a given value. The resin 12 will be hardened by an ultraviolet ray as described in the above after the interval of the curve 48. According to this embodiment since the lowering speed of the pressing plate 4 has been made small only in connection with the stretching operation of the resin 12 as indicated by the curve 48 so that the stretching speed of the resin is set to 10 cm/sec, time required for completing one cycle of the movement of the pressing plate 4 can be maintained short.

In the previous embodiments, it has been described that the stamper 1 is fixed to the stamper mount 3 as shown in Fig. 3. The stamper 1 should be securely fixed to the mount 3 so that no liquid resin penetrates the space between these two members. If the resin 12 were hardened with a portion thereof penetrated the space between the stamper 1 and the stamper mount 3, it would be difficult to detach the produced replica disk, while the quality of the disk would be deteriorated because of occurrence of undulations around the center thereof. Therefore the stamper may have a structure which can be securely fixed to the stamper mount 3 as will be described later. Prior to describing this structure of the stamper, a conventional method of fixing a conventional stamper to a stamper mount will be described for a better understanding of the feature of the above stamper.

Figs. 14 to 16 show the conventional method of fixing a conventional disk stamper 1 to a stamper mount 3. In the conventional method, machining of center hole has been essential. Namely, as shown in Fig. 14, a disk-like stamper 1, which has been formed by plating by an electroforming technique, is machined by means of a punch 51 and a die 52 to make a center hole 50 so that the center hole 50 and the information recorded circular grooves (not shown) are coaxial with each other. Then the center hole 50 is shaped by a press and a forming die (both are not shown) so that the center hole 50 is concave as shown in Fig. 15. The reference 1a indicates a concave center portion. The stamper 1 formed in this way is put on the stamper mount 3, and is fixed, at its periphery, to the stamper mount 3 by means of fixing members (not shown), while the center portion of the stamper 1 is also fixed to the stamper mount 3 by means of a fixing member 53 as shown in Fig. 16. The fixing member 53 is arranged to be screwed in a screw hole made in the center of the stamper mount 3. In detail, the fixing member 53 has a telescopically engaging portion 53a which is arranged to be received in an inner wall 3a placed above the screw hole 53b so that the fixing member 53 is positioned at the center of the stamper mount 3. The reference 53b is a threaded portion of the fixing member 53. The fixing member 53 has a flange portion 53c extending radially, and this flange portion 53c is arranged to be received in a circular recess 3c which is coaxial with the above-mentioned inner wall 3a portion and the screw hole 53b. The stamper 1 is fixed by holding the concave center portion 1a between the flange portion 53 of the fixing member 53 and the circular recess 3c of the mount 3.

However, it is to be noted that an annular gap G is made between the periphery of the flange portion 53 and the upper surface of the concave center portion 1a of the stamper 1. Because of the presence of the annular gap G when injecting and pressing the resin 12, the liquid resin is apt to enter this gap G. If the resin penetrated the gap G were hardened, it would be difficult to detach the formed disk from the stamper 1. Therefore, the disk is apt to be damaged or deformed at the center thereof when detaching from the stamper 1. In addition to such a disadvantage caused by the presence of the annular gap G, the centering accuracy of the center hole of the disk with respect to the information grooves, which is achieved by the flange portion 53c of the fixing member 53 is not high enough. Especially, in the case of producing a video disk in which information is recorded at a high density, centering accuracy has to be very high.

Hence, reference is now made to Figs. 17 to

19 which show the above-mentioned structure of the stamper 1. Fig. 17 is a schematic cross-sectional view of a fixing ring 54 which will be used to fix the disk stamper 1 to the stamper mount 3. The fixing ring 54 is made of a conductive material, and a threaded portion 54 is formed at the inner wall close to one side. At the other side of the inner wall is made an engaging portion 54b which will be engaged with the top of a flange portion of a fixing member as will be described later. The fixing ring 54 is attached to a mother record (not shown), from which a plurality of stampers will be formed, in such a manner that the fixing ring 54 is coaxial with the information grooves of the mother record. Then the mother record is plated by electroforming together with the fixing ring 54. As a result of electroforming, a disk-like stamper 1 is formed, to which the fixing ring 54 has been secured by the electroforming plating. The completed stamper 1 having the fixing ring 54 at its center may be referred to as a stamper assembly, and this assembly is detached from the mother record. The detached stamper assembly is shown in a cross-sectional view in Fig. 18. In order to provide an adequate thickness of the plating around the corner portion C between the lower surface of the mother disk and the outer wall of the fixing ring 54, the outer wall of the fixing ring 54 is inclined or tapered so that the diameter at the upper side of the fixing ring 54 is greater than that at the lower side thereof. Namely, the angle defined between the upper surface and the outer wall of the fixing ring 54 is made obtuse as shown in Fig. 17. Thus, an adequate contacting force between the stamper 1 and the fixing ring 54 is ensured.

Since the stamper assembly 1 may have the above-described structure, the information recorded grooves of the stamper 1 is coaxial with the engaging portion 54 of the fixing ring 54 with high accuracy.

The stamper assembly 1 produced in this way may be attached to the stamper mount 3 of the disk producing device as shown in Fig. 19. Namely, the stamper mount 3 is equipped with a stamper-fixing shaft 25 which corresponds to those of previous embodiments, where the stamper-fixing shaft 25 has a threaded portion 55c arranged to be engaged with a screw hole 3b made in the center of the stamper mount 3. The stamper-fixing shaft 55 has another threaded portion 55a arranged to be engaged with the threaded portion 54a of the fixing ring 54, and an engaging portion 55b at its top to be engaged with the engaging portion 54b of the fixing ring 54. The stamper fixing shaft 55 has a circular outer wall portion 55d arranged to be telescopically received in a circular bore 3a coaxially arranged with the screw hole 3b of the stamper mount 3. Although a center shaft is shown to be engaged with a center bore of the stamper-fixing shaft 55 in Fig. 19, the center shaft may be replaced with the injection valve 26 of previous embodiments.

As described in the above, the stamper assembly 1 can be attached to the stamper mount 3 with a high accuracy in connection with centering between the information recorded portion of the stamper 1 and the center shaft 26 by which the center hole of the disk is defined. Furthermore, since the upper surface of the stamper-fixing shaft 55 is flush with the upper surface of the fixing ring 54 having no gap therebetween, there is no possibility that the liquid molding resin 12 penetrates the space or gap therebetween.

Accordingly, there is no problem due to the presence of the gap G inherent to the conventional attaching method of Fig. 16. This structure of the stamper assembly 1 may be applied to any of the previous embodiments.

After the liquid molding resin 12 has been hardened by applying an ultraviolet ray thereto through the backing plate 2, the produced disk is to be detached from the stamper 1 as described in the above. When detaching or removing the disk fixedly adhered to the backing plate 2 from the stamper 1, the stamper 1 receives an upward force which tends to pull up the stamper 1. As a result, the stamper 1 is apt to be partially raised from the stamper mount 3 or to be deformed. To prevent such undesirable phenomena, it is necessary to securely attach the stamper 1 to the upper surface of the mount 3 not only at the center and the periphery of the stamper 1. Therefore a method of securely fixing the stamper onto the stamper mount 3 by means of a magnetic force may be applied as will be described hereinafter.

Fig. 20 illustrates an embodiment of the above method, in which the stamper 1 is attracted by a flexible magnetic sheet 58 interposed between the stamper 1 and the stamper mount 3. The stamper 1 is made of a magnetic material, such as nickel, and the stamper mount 3 is also made of a magnetic material such as iron or nickel. The magnetic sheet 58 may be adhered to the stamper mount 3 by means of an adhesive. In this case the stamper mount 3 may be made of a nonmagnetic material.

Fig. 21 illustrates another embodiment in which the stamper 1 is attracted by magnetic forces induced by a plurality of electromagnets. Namely, a plurality of coils 59 are embedded in holes made on the surface of the stamper mount 3. In order to make the upper surface of the stamper mount 3 flat, a nonmagnetic material 60, such as brass, aluminum or the like, is filled in the space above respective coils 59. The lines of magnetic force are indicated at 61, passing through the stamper 1. Thus, the stamper 1 is attracted toward the stamper mount 3. The coils are arranged to be supplied with an electrical current from a power source (not shown) via a switch (not shown). The coils 59 may be energized only when the produced

disk is detached from the stamper 1 by turning on the switch.

Since the stamper per se 1 is thin (0.1 to 0.5 millimeters thick) magnetic saturation is apt to occur. In this case, an adequate attracting force cannot be obtained. This problem may be resolved by the following embodiment of Fig. 22. The stamper 1 of Fig. 22 is reinforced by a sheet of a magnetic material, such as iron, nickel or the like, whose thickness is much greater than that of the stamper 1. The sheet 62 is attached to the lower surface of the stamper 1 by means of a suitable adhesive 63. The thickness of the sheet 60 may be 1 to 5 millimeters to provide an adequate attracting force. With this arrangement, the produced disk may be smoothly detached from the stamper 1 without causing the deformation or displacement of the stamper 1.

From the foregoing description, it will be understood that high quality information recording disks can be manufactured since air bubbles are effectively prevented from being taken in the liquid molding resin, while eccentricity of the disk is satisfactorily suppressed. Especially, when copying video disks, high productivity, which could not be obtained up to this time, can be achieved.

Claims

1. A method of producing information recording disks by pressing a synthetic resin by a disk stamper (1), comprising the steps of: placing said disk stamper on a stamper mount (3); supporting a backing plate (2), which will be a part of an information recording disk to be produced, above said disk stamper so that there is a given space between said backing plate and said disk stamper; injecting a liquid molding resin (12) into said space between said backing plate and said disk stamper through a passage made in an injection valve (26) received in a center bore of a stamper-fixing shaft (25) provided at the center of said stamper mount, said injection valve having a flange portion (35) which can be interposed between said backing plate and said disk stamper; depressing said backing plate toward said disk stamper so that the injected resin is stretched outwardly radially; and irradiating the stretched resin layer by an ultraviolet ray so that said resin is hardened, characterized by a step of wetting at least the periphery of said flange portion of said injection valve by said liquid molding resin before said flange portion is in contact with said backing plate.

2. A method as claimed in Claim 1, characterized in that the wetting step is performed by the steps of: injecting a small amount of said liquid molding resin (12) on said stamper (1) and moving said injection valve (26) toward said stamper-fixing shaft (25) so that said resin already injected wets at least the periphery of said flange portion (35).

3. A method as claimed in Claim 1, characterized in that the depressing step is performed by moving said backing plate (2) toward said disk stamper (1).

4. A method as claimed in Claim 1, characterized by a step of closing an outlet (34) of a passage of said liquid molding resin (12) prior to the application of said ultraviolet ray.

5. A method as claimed in Claim 1, characterized by a step of applying a gas pressure to said backing plate (2) so that said backing plate is deformed in such a manner that the space between said backing plate and said disk stamper (1) is greater at its periphery than that at its center.

6. A method as claimed in Claim 1, characterized in that the moving speed of said backing plate (2) in the depressing step is controlled so that the stretching speed of the injected resin (12) is less than 10 cm/sec.

Revendications

1. Procédé de fabrication de disques supports d'information par pressage d'une résine synthétique au moyen d'un disque 1 d'estampage, comprenant les phases de: placement du disque d'estampage sur un support (3); soutien d'une plaque (2) d'appui, qui fera partie du disque support d'information à produire, au-dessus du disque d'estampage de manière à ménager un espace déterminé entre la plaque d'appui et le disque d'estampage; injection d'une résine à mouler liquide (12) dans l'espace ménagé entre la plaque d'appui et le disque d'estampage, à travers un passage pratiqué dans une buse (26) d'injection passant dans l'alésage central d'un axe (25) de fixation du disque d'estampage, prévu au centre du support du disque d'estampage, cette buse d'injection comportant une partie (35) en collerette qui peut s'interposer entre la plaque d'appui et le disque d'estampage; abaissement de la plaque d'appui vers le disque d'estampage de telle manière que la résine injectée s'étire radialement vers l'extérieur; et irradiation par un rayon ultra-violet de la couche de résine étirée pour durcir la résine, ce procédé étant caractérisé par une phase de mouillage du pourtour au moins de la partie en collerette de la buse d'injection par la résine à mouler liquide avant que la partie en collerette ne soit en contact avec la plaque d'appui.

2. Procédé suivant la revendication 1, caractérisé en ce que la phase de mouillage comprend les opérations suivantes: injection d'une faible quantité de la résine à mouler liquide (12) sur le disque d'estampage (1) et déplacement de la buse (26) d'injection vers l'axe (25) de fixation du disque d'estampage de sorte que la résine déjà injectée mouille le pourtour au moins de la partie (35) en collerette.

3. Procédé suivant la revendication 1, caractérisé en ce que la phase d'abaissement est

effectuée par le déplacement de la plaque (2) d'appui vers le disque (1) d'estampage.

4. Procédé suivant la revendication 1, caractérisé par une phase de fermeture d'un orifice de sortie (34) de passage de la résine à mouler liquide (12) avant l'application du rayon ultraviolet.

5. Procédé suivant la revendication 1, caractérisé par une phase d'application d'une pression de gaz à la plaque (2) d'appui de sorte que cette dernière est déformée de telle manière que l'espace compris entre la plaque d'appui et le disque (1) d'estampage soit plus grand à sa périphérie qu'en son centre.

6. Procédé suivant la revendication 1, caractérisé en ce que la vitesse de déplacement de la plaque (2) d'appui dans la phase d'abaissement est réglée de façon que la vitesse d'étirage de la résine injectée (12) soit inférieure à 10 cm/s.

Patentansprüche

1. Verfahren zur Erzeugung von Information aufzeichnenden Scheiben durch die Pressung eines synthetischen Harzes mittels eines scheibenförmigen Stößels (1), das folgende Schritte umfaßt: Anbringen des scheibenförmigen Stößels an einer Stößelanbaustelle (3), Lagerung einer Versteifungsplatte (2), die ein Teil der herzustellenden Information aufzeichnenden Scheibe ist, oberhalb des Stößels so, daß zwischen der Versteifungsplatte und dem Stößel ein gegebener Abstand ist, Einspritzen eines flüssigen Formgebungsharzes (12) in den Raum zwischen der Versteifungsplatte und dem Stößel durch einen Kanal, der in einem Einspritzventil (26) ausgebildet ist, das in einer mittigen Bohrung einer Stößelbefestigungswelle (25), die in der Mitte der Stößelanbaustelle vorgesehen ist, aufgenommen ist, wobei das Einspritzventil einen Flanschabschnitt (35) hat, der zwischen der Versteifungsplatte und dem Stößel angeordnet werden kann, Niederdrücken der Versteifungsplatte auf den Stößel zu so, daß das eingespritzte Harz radial nach außen gedehnt wird, und Bestrahlung der gedehnten Harzschicht mittels ultravioletter Strahlung, so daß das Harz gehärtet wird, gekennzeichnet durch einen Schritt der Benetzung zumindest des Umfangs des Flanschabschnitts des Einspritzventils mit dem flüssigen Formgebungsharz bevor der Flanschabschnitt in Berührung mit der Versteifungsplatte steht.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Benetzungsschritt in folgenden Stufen durchgeführt wird: Einspritzen einer geringen Menge des flüssigen Formgebungsharzes (12) auf den Stößel (1) und Bewegung des Einspritzventils (26) auf die Stößelbefestigungswelle (25) zu so, daß das bereits eingespritzte Harz zumindest den Umfang des Flanschabschnittes (35) benetzt.

3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Schritt des Niederdrückens durchgeführt wird, indem die Versteifungsplatte (2) auf den Stößel (1) zu bewegt wird.

4. Verfahren nach Anspruch 1, gekennzeichnet durch einen Schritt des Schließens eines Ausgangs (34) eines Kanals für das flüssige Formgebungsharz (12) vor der Anwendung der ultravioletten Strahlung.

5. Verfahren nach Anspruch 1, gekennzeichnet durch einen Schritt der Beaufschlagung der Versteifungsplatte (2) mit einem Gasdruck so, daß die Versteifungsplatte derart deformiert wird, daß der Abstand zwischen der Versteifungsplatte und dem Stößel (1) an ihrem Umfang größer als in ihrer Mitte ist.

6. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Bewegungsgeschwindigkeit der Versteifungsplatte (2) beim Schritt des Niederdrückens so gesteuert ist, daß die Dehngeschwindigkeit des eingespritzten Harzes (12) kleiner als 10 cm/sec ist.

FIG. 1
PRIOR ART

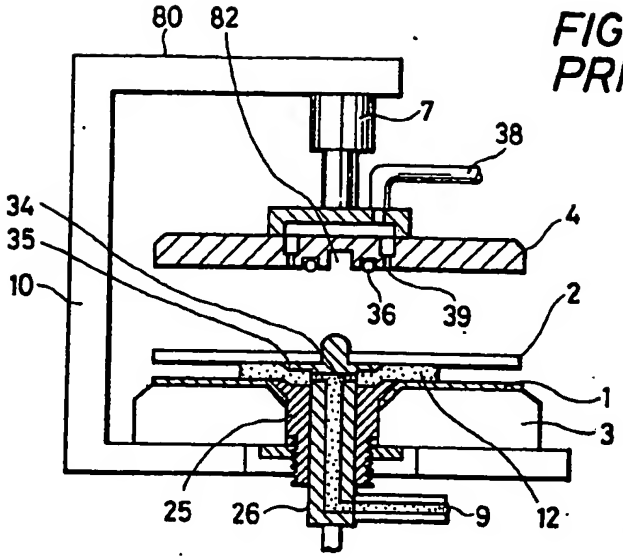

FIG. 2

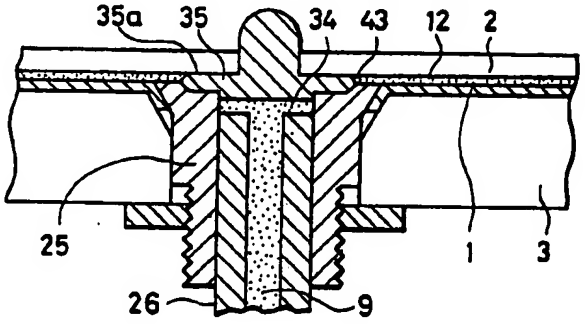

FIG. 3

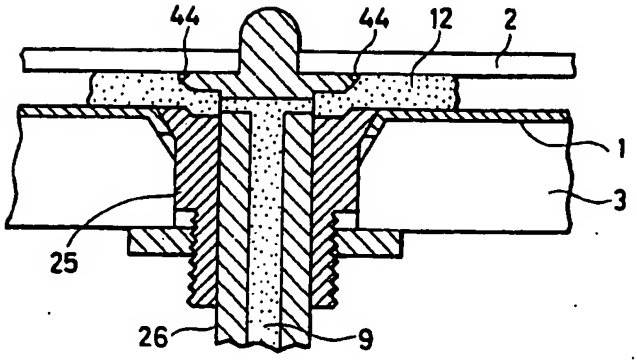

FIG. 4

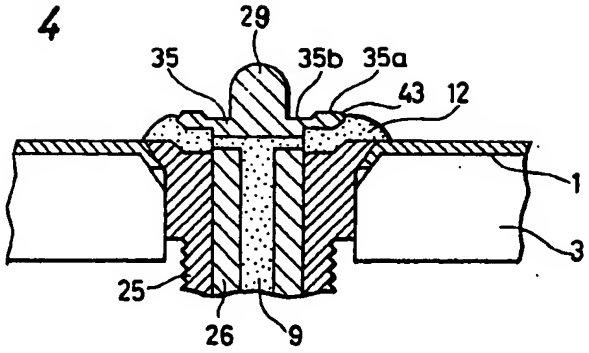

FIG. 5

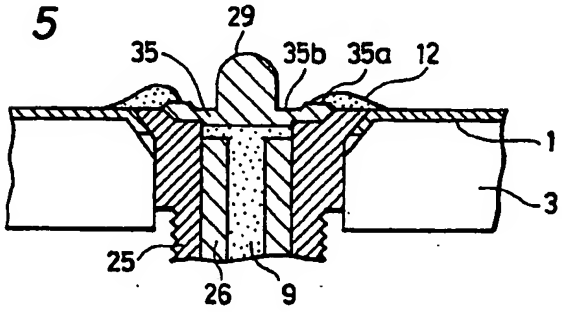

FIG. 6

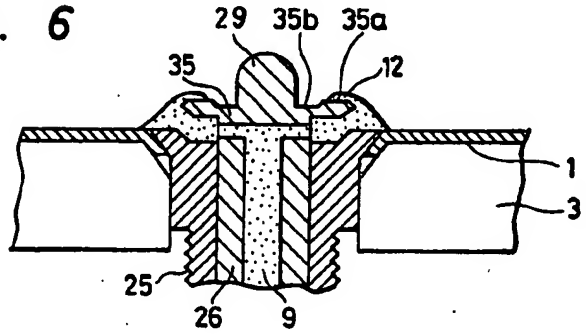

FIG. 7

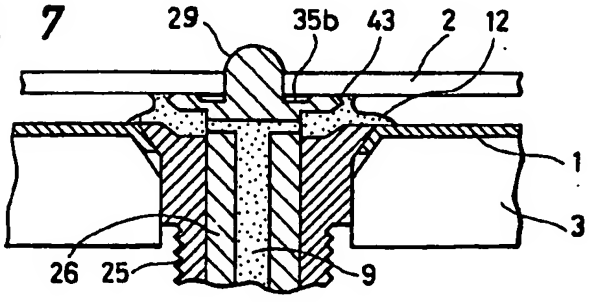

FIG. 8

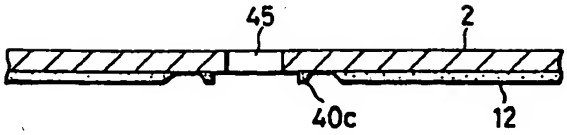

FIG. 9

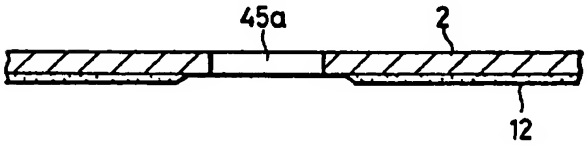

FIG. 10

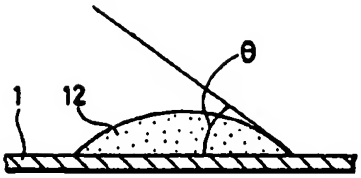

FIG. 11

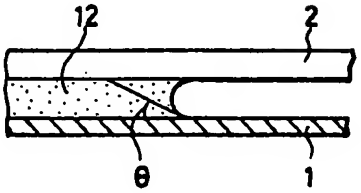

FIG. 12

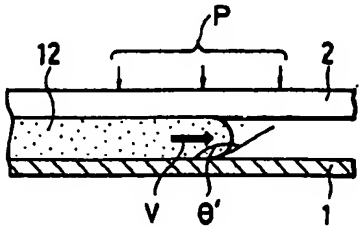

FIG. 13

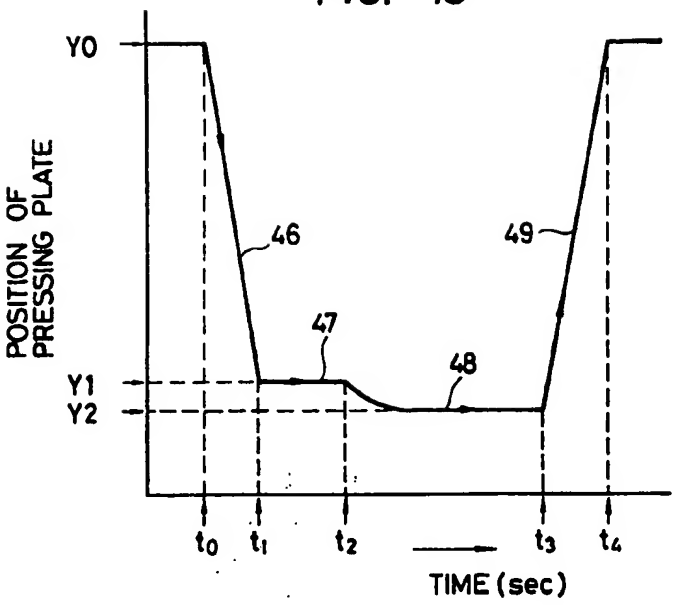

FIG. 14
PRIOR ART

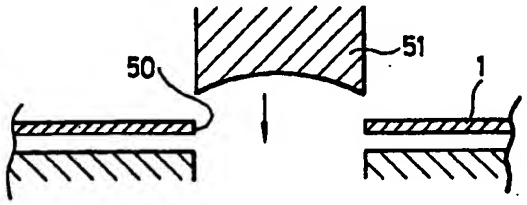

FIG. 15
PRIOR ART

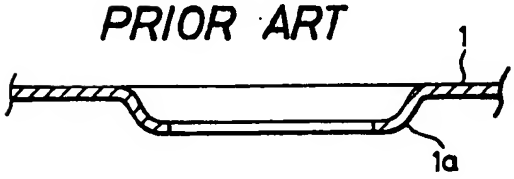

FIG. 16
PRIOR ART

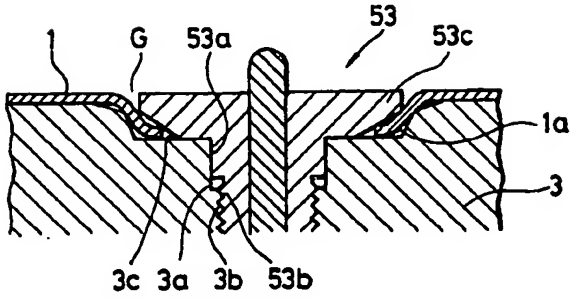

FIG. 17

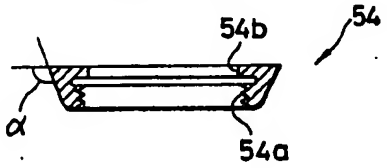

FIG. 18

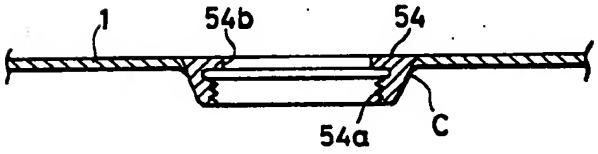

FIG. 19

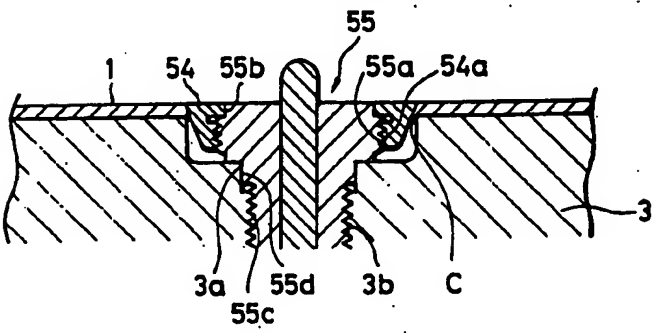

FIG. 20

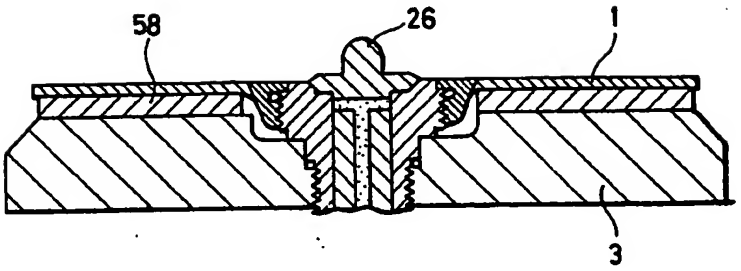

FIG. 21

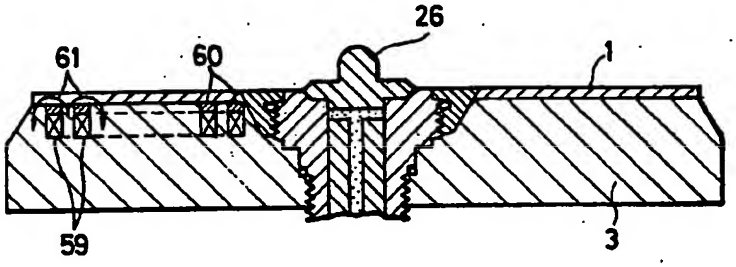

FIG. 22